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Unit 2
A.5 Investigating Matter: Metal or Nonmetal?

Introduction

In this activity, you will investigate several properties of seven elements and then decide whether each element is a metal, a nonmetal, or a metalloid. You will examine the color, luster, and form of each element, and you will also attempt to crush each sample with a hammer. In addition, you or your teacher (as a demonstration) will test the substance's ability to conduct electricity. Finally, you will determine the reactivity of each element with two solutions: hydrochloric acid, HCl(aq), and copper(II) chloride, $CuCl_2(aq)$.

Before starting, read the procedure to learn what you will need to do, note safety precautions, and plan necessary data collecting and observations. In your data table, create six columns: one column will be used to list the elements tested, and the other five columns will be used to record each result for appearance, conductivity, crushing, reactivity with copper(II) chloride, and reactivity with acid.

Procedure

1. Construct a data table or use the one provided for recording your data.
2. ***Appearance:*** Observe and record the appearance of each element, including physical properties such as color, luster, and form. You can record the form as nonmetallic (like table salt, NaCl, or baking soda, $NaHCO_3$) or metallic (like iron, Fe).
3. ***Conductivity:*** If an electrical conductivity apparatus is available, use it to test each sample. (***Caution:*** *Avoid touching the bare electrode tips; some may deliver an uncomfortable electric shock.*) Touch both electrodes to the element sample, but do not allow the electrodes to touch each other. See Figure 2.6 of your textbooks. If the bulb lights, even dimly, electricity is flowing through the sample. Such a material is called a **conductor.** If the bulb fails to light, the material is a **nonconductor.**
4. ***Crushing:*** Gently tap each element sample with a hammer as shown in Figure 2.7 (page 116 of your textbook). Based on the results, decide whether the sample is **malleable,** which means it flattens without shattering when struck, or **brittle,** which means it shatters into pieces.
5. ***Reactivity with copper(II) chloride.***
   a. Label seven wells of a clean wellplate *A* through *G.*
   b. Place a sample of each element in its well. The ribbon or solid wire samples provided by your teacher will be less than 1 cm in length. Other samples should be between 0.2 g and 0.4 g. You can estimate that amount as being no larger than the size of a match head.
   c. Add 15 to 20 drops of 0.1 M copper(II) chloride ($CuCl_2$) to each sample.
   d. Observe each system for three to five minutes—changes may be slow. A change in a sample's appearance may indicate a chemical reaction. Decide which elements reacted with the copper(II) chloride and which did not. Record these results.
   e. Discard the wellplate contents as instructed by your teacher.
6. ***Reactivity with acid.***
   a. Repeat Steps 5a and 5b.
   b. Add 15 to 20 drops of 0.5 M HCl to each well that contains a sample. (***Caution:*** *0.5 M hydrochloric acid (HCl) can chemically attack skin if allowed to remain in contact for a long time. If any hydrochloric acid accidentally spills on you, ask a classmate to notify your teacher immediately. Wash the affected area immediately with tap water and continue rinsing for several minutes.*)
   c. Observe and record each result. The formation of gas bubbles may indicate that a chemical reaction has occurred. Decide which elements reacted with the hydrochloric acid and which did not. Record these results.
   d. Discard the wellplate contents as instructed by your teacher.

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7. *Wash your hands thoroughly before leaving the laboratory.*

Questions

1. Classify each property tested in this activity as either a physical or chemical property.

   Appearance: _____

   Conductivity: _____

   Crushing: _____

   Reaction with HCl: _____

   Reaction with $CuCl_2$ _____

2. Sort the seven coded elements into two groups based on similarities in their physical and chemical properties.

   _____

   _____

   _____

3. Which element or elements could fit into either group? Why?

   _____

   _____

4. Using the following information, classify each tested element as a metal, a nonmetal, or a metalloid:
   - Metals have a luster, are malleable (can be hammered into sheets), and conduct electricity.
   - Many metals react with acids; many metals also react with copper(II) chloride solution.
   - Nonmetals are usually dull in appearance, are brittle, and do not conduct electricity.
   - Metalloids have some properties of both metals and nonmetals.

Element	Metal	Nonmetal	Metalloid
a.			
b.			
c.			
d.			
e.			
f.			
g.			

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Data Table

Element	Appearance	Conductivity	Result of Crushing	Reaction with HCl	Reaction with $CuCl_2$
a.					
b.					
c.					
d.					
e.					
f.					
g.					